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VOLUME VIII, NUMBER 3, MARCH 1959

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The editors invite the submission of articles, discussions, research reports, news items, and reviews of books and documents. Address manuscripts and other matters involving editorial policy to: The Editors, THE FEDERAL ACCOUNTANT, at either 1523 L St., N.W., Washington 5, D.C., or the Graduate School of Business and Public Administration, Cornell University, Ithaca, New York.

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THE WHITE HOUSE

Washington
November 7, 1958

A Message from the President of the United States

to be read by The Honorable Maurice H. Stans
to the Federal Government Accountants Association
November 17, 1958

Please give my greetings to the members of the Federal Government Accountants Association assembled in their Eighth Annual National Symposium.

The operations of our Government are immense and diversified; they extend into almost every corner of the world. It is essential that these operations be managed with utmost care and efficiency. In this vital area, effective financial systems that produce timely and meaningful information can help us greatly in reaching decisions which will result in better public service and more value for every tax dollar.

Toward these goals, through the study of financial management problems and the dissemination of practical information, the Federal Government Accountants Association makes a notable contribution. I am delighted to send them my best wishes for a fine meeting and for the continuing success of their programs.

DWIGHT D. EISENHOWER

The articles in this issue of THE FEDERAL ACCOUNTANT are based on papers given at the:

*Eighth Annual Symposium**

MANAGEMENT AND ELECTRONIC DATA PROCESSING

Sponsored by

FEDERAL GOVERNMENT ACCOUNTANTS ASSOCIATION

Held at

WASHINGTON, D.C.

November 17 and 18, 1958

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*The speeches of DeCarlo, Alexander, and Cadematori will be presented in the June issue of THE FEDERAL ACCOUNTANT.

Participants in the Eighth Annual Symposium

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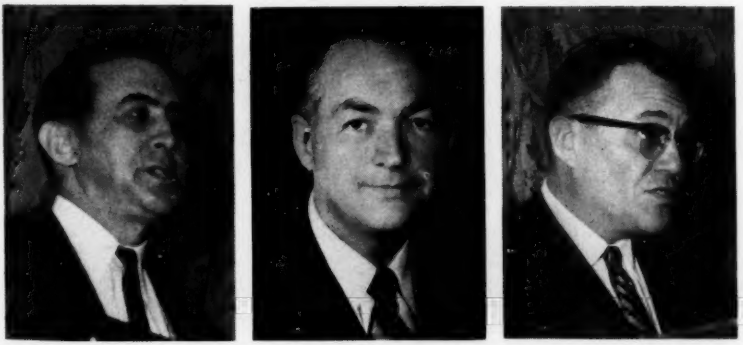

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Eighth Annual Symposium, sponsored by the FGAA.

Roger H. Bender

Profiting from the Mistakes of the Past

Electronics data-processing systems, at first greeted with unbridled optimism, have resulted in many disappointments when the expected savings did not materialize. Nevertheless, data processing is a growing industry with many satisfied users.

Three categories of difficulties are those encountered in selection of the equipment, in preparation for the use of the equipment, and in the selection of the jobs to which the equipment will be applied.

Dr. Bender is Assistant Director, Application Department, DATAmatic Division, Minneapolis Honeywell Regulator Co.

THE subject of this article, "Profiting from the Mistakes of the Past," permits me to draw from an infinite source of material — even when I limit my topics to those pertaining to large-scale electronic data-processing systems. Those who already have their own equipment perhaps have already encountered some of the difficulties and made some of the mistakes which I will discuss here. These people are beyond any help that I can give them. But, I feel that organizations that are preparing to use, or those that are only considering the use of, electronic data-processing equipment should be made aware of the difficulties and mistakes of their predecessors in the hope that these examples will help them avoid the difficulties and prevent any repetition of the mistakes.

Before I am fully launched on a discussion of mistakes of the past, I think that it is necessary to state that I am firmly in the camp of computer boosters.

The most startling indication that difficulties do exist can be gleaned from the tenor of the American Management Association's annual electronics meetings. In the first meeting in 1955, unbridled optimism was expressed throughout the meeting, and participants were full of blue-sky plans. The 1956 and 1957 meetings reflected the change in mood from that of 1955 to that of 1958, where many expressed disappointment and complained that expected savings had not materialized. I would like to be able to deny all such claims but I am afraid that some of these reports may be all too true. I would like to think that my voice in the wilderness could have some effect toward improving this situation. If you should come to the conclusion that the picture is all black, I will have led you astray. There are many satisfied users, and there are more every day. However, this is a new industry, and it has had its growing pains and will probably continue to have them.

I propose to discuss three categories of difficulties, namely, those encountered in the selection of the equipment, those encountered in the preparation for the use of the equipment, and those encountered in the selection of the job to which the equipment will be applied. I do not claim that what I say is new or revolutionary, but I feel that there is a need for repeating this information.

EQUIPMENT SELECTION

Most organizations that embark on the selection of an electronic data-processing system are neophytes at the job, and the variety of systems on the market makes a bewildering array from which to choose. Some groups, when faced with this task of evaluation, will simply present their present office procedures to all interested manufacturers and permit them to design a new set of procedures best suited to their equipment and which will accomplish the same end results as the original manual or tab system. This free-for-all procedure-design competition is certainly productive of some interesting ideas, but it almost always leaves no common basis of comparison of capabilities of the various proposed electronic data-processing systems. The situation is complicated by the fact that

usually each such procedure misses complete acceptance by the selection organization. This is usually due to the communications difficulties between the selecting organization and the manufacturer.

A second approach to the selection job is for the selecting group to define completely the procedures to be employed by the electronic data-processing system down to the last character in the record design and the smallest computer run. The difficulty to this approach is that some lucky manufacturer is going to walk into a job tailored to his equipment, and other manufacturers will find themselves hopelessly handicapped with problem requirements that cannot possibly be economically met but that could be met with variations of the intermediary steps toward the end.

There is a middle ground between these two extremes which has been achieved. The problem must be well enough defined to avoid misunderstanding, but also there must be enough flexibility to permit variations demanded by the various types of equipment.

The extreme variations among the electronic data-processing systems on the market today and an apparent lack of time to learn about all of them (or any of them in the selection stage) has led frequently to the attempt to "evaluate the equipment by the numbers". This is what I call those attempts to fill out comparison charts of machine performance without sufficient backup knowledge. As an example, suppose computer A had an addition time of 100 microseconds and computer B had an addition time of 75 microseconds. Obviously computer B is better at addition. But is it? Do the two additions do the same amount of work? Are the additions quoted one, two, or three address orders? Are the times quoted the times to add two digits, the time to add two fields, or the time to add two words? When these questions are resolved, it may well be that computer A is faster at addition than computer B. The next question to be asked is whether the addition time is important in the particular application in question or whether other considerations far outweigh it. All too often the purpose of the comparison chart is to avoid these questions in the first place; so they are never asked, and a very distorted picture of comparative computer performance is the result.

Another evaluation method that is frequently used (and one that

I am much in favor of if it is used properly) is the sample program. The group selecting equipment submits a problem to be programmed and coded by each manufacturer. The booby trap here is that usually the problem chosen is a small one, making it very difficult to represent all phases of the complete problem. If it is not representative of the complete problem, then a false conclusion will probably be reached as to the relative merits of the competing equipments. Care must be exercised to select a problem that includes input, output, editing, sorting, file maintenance, and arithmetic and logical operations in approximately the same proportions as the over-all problem. Yet, brevity is still desirable. Usually sorting can be omitted from the sample program but should be considered.

Recently I was talking to the head of a computer installation which has three systems, not all by the same manufacturer, and I asked him how close the proposal estimates made by the manufacturers as to the time usage of the equipment had been to actual running time. He admitted that in all three cases actual time was more than twice that estimated. I do not believe that this situation is too unusual. Yet he did not consider it to be an indictment of the manufacturers. Since my job involves the preparation of proposals, I am forced to agree with him. What usually happens is that the manufacturer submits an honest and probably accurate proposal for the problem that has been given to him. The difficulty is that this problem is not the one that goes into production. From the time of the proposal until production, a year to a year and a half of study and work have gone into the problem definition, and the problem has substantially changed. Detail has been supplied to fill in the original bare bones. It is hoped that the problem is better understood. Humans, being only human, are basically optimists, and unless difficulties are clearly seen, they are not expected to exist. Hence, the problem covered by the proposal is simpler than the final problem.

In addition to the estimated time for a given application increasing, the number of applications grows. Once the equipment is available, everybody wants to get into the act. The service furnished by an installation makes it very popular; everybody wants to benefit by this new tool, and usually the big task of the group operating

a computer is not to find new applications but rather to weed out the best ones from those clamoring to use the equipment.

Enough reserve capacity must be inherent in the equipment ordered to provide for these two types of growth of the load. However, there is a third factor which tends to lead to the acquisition of equipment with extra capacity for work that must be guarded against. This is false problem definition. Although the day of prestige buying of electronic data-processing equipment is essentially over, vestiges of it remain. An equipment selection committee has heard of a particular feature available in data-processing equipment, and they are impressed by it. So they design their problem to require this feature, and regardless of what it costs them they insist on keeping its use in the problem. An example of this comes to mind in a problem that had transactions against their file arriving by first-class mail, frequently several days in transit. But once this data arrived at the data-processing center, it was required to be processed within minutes. I do not know what this requirement cost them, but I am sure that it was a considerable amount, and I am sure that it was wasted. But this group was apparently intent on spending this extra money because they wanted to say that they processed their data within minutes after it arrived. Every requirement must be carefully examined to see if it is real or imagined.

PREPARATION FOR USE

Let us now assume that the equipment has been selected and the work in preparing for its use has begun. The first question that comes to my mind is that of personnel. Who is going to do the work? There are frequently two different reactions when the job of programming is mentioned, and, surprisingly, they are opposites. One reaction is that programming is too technical and difficult, that only a trained mathematician can understand it. The other reaction is that programming is a dull, clerical job that any drudge can do and is, therefore, beneath the dignity of men of talent and ability. Obviously, at least one of these points of view must be in error, and I am inclined to believe that both of them are.

In actual fact, programming is comparatively easy to learn, and this is demonstrated by the number of organizations that train their own employees to program rather than hire programmers

and teach them the activities of the organization. I agree with this procedure. The difficulty arises because it is not the people who know the job thoroughly who do the programming. Rather, once the problem has been defined, the department head or the methods-and-procedures man turns the programming over to a programmer for either of the two reasons stated above, thus creating a difficult communications problem. This technique is the classical one in the computer field. It grew up in the days when computer use was restricted to scientific problems, and it worked very well in these circumstances because it was comparatively easy for the mathematical analyst to define the problem completely by a few well-chosen formulae. In a data-processing problem, except for a few well-defined operations such as sorting, it is usually impossible to define the problem so concisely.

Therefore, the problem definition to the programmer is a continuous affair still in progress up to the time the program is completely checked and ready for use (and, unfortunately, sometimes even beyond). This constitutes an inherent duplication of effort that can be avoided only by having the man who defines the problem originally do the programming, at least a part of it. A firm recently used an advertisement in which it was stated that in one of their installations all the programming was done by the heads of the departments involved. I realize how difficult this practice would be for most organizations, but I believe that this is the best way to get the programming job done. I also believe, on the basis of personal experience, that these men, or women, will make good programmers and will enjoy it.

In the preparation for the use of electronic data-proceessing equipment there are some activities, such as the selection of personnel, which must come early in preparation. There are others which are habitually relegated to the final stages. Some of these, however, do not belong there. One that does not is the problem of conversion of data from the old system to the electronic system. It seems so illogical to find a programming group that has been worrying for months about how to control daily input data to their proposed system but have not considered the same problem for the data that goes to make up their files originally. Yet I have found this happening in several instances. Months are spent worry-

ing about the accuracy of transaction data, yet the accuracy of the original files is taken for granted until the final weeks. A recent report on a group of government computing installations illustrated how serious a mistake this can be. The mistake is a natural one, since the data in question has constituted the basic records of the organization for years and the organization is hale and hearty. Hence, the data must be good. However, the report referred to above indicates that data was found to be in extremely poor condition, so poor that in one instance the data was thrown away and a completely new set was compiled from scratch. A program of data purification should be planned for early.

Since electronic data-processing systems are such powerful devices, it is normal to redesign all record-keeping procedures to take advantage of this power and to expand the data-processing operation. It is possible now to keep more complete records than ever before — that is, it is possible to keep these expanded records up to date if it is possible to acquire them in the first place. There have been several instances where pieces of information have been hypothesized in a magnetic tape file, the programs prepared on this basis, and then it is discovered that this information is simply not available in any records the organization has. Thus, it is impossible to place this information on magnetic tape in the first place, and all the careful planning was for naught. The mistake, of course, was in not examining the availability of data at a sufficiently early stage.

In all data-processing operations there are persons not directly involved in the data-processing effort but who, nevertheless, receive data from the processing effort and who must either accept or reject this data. From a purely psychological point of view, if the technique of generating the data they receive is changed from that which has proven acceptable to them for a period of years and they have not been consulted about this change, they are going to fear this change. These auditors — and in most senses this is their function whether it is their title or not — will never feel comfortable about the reliability of the new data source until it has proved reliable for a period of months and even years. Thus, from a psychological, as well as practical, point of view it is wise to consult with these auditors from the very beginning of the preparation

for use of an electronic data-processing system. Obtain the auditors' approval at the problem-design stage so that they know what the results are intended to be, consult them at the program-checking stage so that they can be satisfied that the results are correct. Arrange for them to design their own tests of the data-processing system. Then they have no alternative but to accept the results. They have had an opportunity to understand what is taking place and have had ample opportunity to convince themselves of the validity of the results.

There is an additional point I wish to make about the preparation for use of electronic data-processing systems. As a representative of a manufacturer, I hesitate to bring the point up for fear that I will be misunderstood. In the early days of data processing, the manufacturers were criticized for not giving enough support to their customers during these preparation activities. Now I believe that the pendulum has swung full cycle and that the customers are becoming too dependent on the manufacturers. The manufacturers of data-processing equipment encourage the acceptance by the customer of so-called automatic programming aids, that is, assembly routines, compilers, interpretive routines, and automatic checkout routines. In addition, there are libraries of "canned" routines made available, such as sort routines, input routines, and edit routines. These are regarded today almost as part of the hardware which the customer acquires. But they are accepted without any regard as to their efficiency. No comparison is made of the costs of programming a routine tailor-made for the job with the costs of using a less efficient generalized routine (and hence more computer time) on a daily basis for an extended period. Also, the acceptance of these routines tends in many cases to hinder the training of customer personnel. No one bothers to learn machine language, and the capability of writing "tight" programs where time or space is of great value is lost. Problem preparation is of course cheaper, but this may not outweigh hidden extra costs.

SELECTION OF THE JOB

Selection of the job is perhaps more important than the areas I have already touched on. Yet, I have left it to the last because it has received the most comment throughout the years, and hence the material presented here is much more widely known. It has been

said that a computer expert is a man who has not yet received delivery of his equipment. I really think this is unfair. A computer expert is a man who has not yet ordered his equipment. By the time he has ordered equipment and started preparation for its use, he has begun to come face to face with stern reality, namely, that his equipment's capacity to perform work is greater than his or his staff's ability to organize work.

When I first turned from the relatively precise field of scientific computation to investigate the application of computers to data processing, I was amazed by what appeared to me to be a serious lack of precise information that organizations possessed about their data-processing problems. During the intervening years I have ceased to be amazed, but as a mathematician this lack of preciseness still bothers me. All organizations have, sometime in their development, made some attempt to formulate their data-processing procedures in a concise and precise manner. But before the advent of electronic equipment, there was always frequent human intervention in this processing. Thus, if a situation arose that was not covered in the rules, a human intervened, employed his experience and judgment to clear the situation, and processing went on as before. Usually no records are even kept of these occurrences. But in electronic systems, human intervention of this type is difficult and costly, so the rules must cover all possible conditions. When it is not known what all the possible conditions are, the corresponding rules are difficult to formulate.

Many organizations developed their data-processing procedures as an evolutionary process; through the years they have been modified and added to as emergencies arose in a continuous effort to meet external changes and demands. Frequently the reason for some of the effort is obscured; present job incumbents process data the way they do only because it was done that way when they first came to work. The man who initiated the activity has since retired or left the organization and the underlying reasons went with him. It is difficult to determine whether a report is produced today only because it was started several years ago and nobody turned it off when its usefulness was over or whether it is still required. It is also difficult to determine whether some processes are as they are because of equipment limitations or by intent.

This is the situation then that faced the men who in 1955

expressed such optimism about "push button offices." Since then, as the equipment increases in capacity and flexibility, the goals are becoming more modest. I am sure that the magnitude of the task was not fully appreciated at that time.

Some men who have attempted to unravel the complexities of existing data-handling systems have attempted to side-step the task by scrapping all existing procedures and asking management to enumerate the information needed to run the organization efficiently. In the instances in which I have first-hand information, this action solved no problems, because management was unable to comply and the attempt to start from scratch was thwarted before it fully began.

Thus, in selecting jobs to be implemented on a computer, those jobs which were best defined, which were already well mechanized, were singled out as the first computer applications. Bits and pieces of the over-all record-keeping and data-processing activity, such as payroll and post-mortem inventory records, were selected and costs were justified on a clerk replacement basis. These individual jobs are, of course, ideally suited for computers, but they are far from the total job and many, myself included, do not believe they are the ones which will furnish the largest cash benefits. The cash benefit from these jobs is, as a matter of fact, probably small, since these jobs were the ones being done most efficiently under the previous system.

Take the example of a business organization which can assemble its 1957 operating statistics by April of 1958, can analyze them and use them to formulate operating policy for 1959 by late October of 1958. This business is then always one to two years out of touch with reality. What cash benefit would accrue to this business organization if a computer could keep them up to date, month by month, at no clerical saving or even at an additional clerical cost. The saving, of course, is an intangible, but I would certainly welcome the opportunity to try to realize it. This is not, incidentally, a contrived example, but rather an actual schedule in use today. The people saddled with it are also anxious to improve their lot.

I believe that the use of computers in data processing will show its greatest advantage and savings in making available more current and more complete operating information. With the realization

that this can be done only by a revolutionary change in procedures rather than an evolutionary one and with the example and guidance of successful predecessors, coupled with the availability of still better computing equipment, more and more people will achieve the goals so eagerly described in 1955 and which have been so elusive until now.

If one of you should walk into my office and find fault with my operations, as I have done here with unnamed organizations, my reaction would be quite predictable. I trust that some of you have managed to pursue your data-processing activities in such a manner as to make my enumeration of mistakes inapplicable. If, on the other hand, I have tread on some toes, it was done in a humanitarian spirit in the hope that some benefits would accrue.

Thomas R. Bitterly

Magnetic Ink Character Developments

Machines were introduced in 1958 which rank among the important technical developments of the past ten years. The machines are the first banking device to utilize magnetic ink character recognition and process automatically checks and deposits at speeds as high as 750 per minute.

This new concept of paper processing will not be limited to banking. It will also be applicable to other areas of industry and government.

Mr. Bitterly is Assistant Manager, Electronic Machine Sales, The National Cash Register Company.

WHEN the events of this decade, the nineteen-fifties, are finally recorded, it is more than probable that historians will call it "the Electronic Decade." Within this decade, we have seen the development, growth, and maturity of the electronic computer, and, particularly of interest to the government accountant, we have seen the successful application of the electronic computer and related automation equipment to data processing or accounting applications. The decade has witnessed also almost incredible progress in other fields in which electronics play a fundamental part — the spectacular earth satellites, the intercontinental ballistic missiles and now "moon shoots."

Progress has been so rapid in so many directions that it is difficult for the individual to keep completely abreast of his own

specialty in the electronic field and at the same time to be fully informed on the technical facts and events which are significant in related fields. One of the fields which may be related to your own is the field of banking operations or banking systems.

On the twenty-first of September an event took place at the American Bankers Association Convention in Chicago in which the interest of those concerned with the technical advance of banking systems was as intense as was the interest in the recent "moon shoot" to those concerned with space problems. This event, I feel, will rank as one of the important technical "firsts" in the field of automation during this Electronic Decade. The event that created such tremendous interest among the assembled bankers was the first public showing and release for sale of equipment designed to automate check processing, a major bank application. Never in the history of banking conventions has there been such a "show-stopping" performance by a group of machines.

The machines on display were the first known banking devices to be shown publicly that utilize magnetic ink character recognition, the common language for check handling. Specifically, the machines shown were a magnetic character sorter-reader, a proof machine with magnetic character imprinter, an automated bank-posting machine, and a machine called a qualification imprinter.

The objective of this automation program, supported jointly by the banking industry and the various machine manufacturers and check printers, was to create an entirely new line of equipment which could be used to process automatically the checks and deposits which flow daily through the nation's banks. The banking industry ultimately expects to process the more than nine billion checks drawn annually by means of magnetic ink character-recognition equipment. This means that the majority of the more than fifty-five million individuals and organizations that have checking accounts will eventually use checks and deposit tickets having information relative to the processing of these documents encoded in magnetic ink characters in a specially designated area across the bottom of the document.

The development of the magnetic ink character-recognition system and related equipment has been a tremendous undertaking. This new concept of paper processing will not be limited to banking. Its impact will be felt in other fields than banking.

I would not presume to tell you how magnetic ink character-recognition equipment will find application in the federal government. I am confident that you will be in a much better position to evaluate its potential for government use. My purpose is to acquaint you with some of the technical aspects of this new equipment so that you may make your own assessment.

This common language for banking, called magnetic ink character recognition, was brought into being through the co-operation between members of the American Bankers Association and various manufacturers, printers, and allied members of the office equipment industry. During 1953 and early 1954, when electronic computers first made their appearance, forward-thinking banking officials recognized that this new technology of automation would ultimately affect the operations of the banking system. It was recognized that unless a common language was agreed upon at an early date the full advantages of automation would be denied the banking industry. There was a wide variety of languages being proposed as machine languages. If this condition prevailed, a tower of Babel might forever bar effective interbank automation. With this knowledge the Bank Management Commission of the American Bankers Association appointed the Subcommittee on Mechanization of Check Handling on April 5, 1954. The chairman of this committee is John A. Kley, Executive Vice President of the County Trust Company, White Plains, New York. This act, the selection and appointment of the members of this committee, and the promptness with which the committee acted insured at the inception the successful adoption of a common language for banks. For this group of able bankers, headed by Mr. Kley, has worked tirelessly and with great skill to bring direction and ultimate solution to a problem which could have failed because of the intrusion of individual and competitive bias.

Time does not permit a discussion of the factors that led to a final selection of the common language for banks. The work of the committee has been summed up and reported in four booklets published by the American Bankers Association, covering the selection of the common language, the position of the codes on each check, the data to be coded, account numbering, and check imprinting.

The fact of importance to us is that magnetic ink character recognition was adopted in July 1956 as the common machine language most suitable for mechanized check handling by the Bank Management Commission of the American Bankers Association. Subsequent to the publication of the recommendation all of the major machine manufacturers and the representatives of the check printing industry added their support to the recommendation. It was the carefully considered judgment of everyone concerned that magnetic ink character recognition would provide the following benefits:

1. The greatest accuracy. An error rate of one in 100,000 is now possible, and it is reasonable to expect further improvement.

2. The least stringent printing tolerance requirements, including those for the actual printing processes and the cutting and perforating operations. Also the problem of uniform ink coverage is less for the magnetic ink reading equipment than other type codes, thus permitting more latitude in post-printing equipment.

3. The most acceptable language from a customer viewpoint. Of course, there will be some changes in check format and in the appearance of checks, but the code is easily readable and can be verified by all, and it requires the least revision in format of any of the visible codes.

4. Positive verification procedures during internal proving operations. The amounts are printed in Arabic numerals, and the bank and customer are assured that what has been printed has been used in the accounting procedure.

5. The lowest over-all costs. Wider tolerances eliminate the need for new and expensive printing equipment, thus minimizing printing costs. Magnetic inks will be no more costly than other types of special inks. Checks may be imprinted in a single run and with one inking. No special decoding equipment is required for verification purposes.

6. The least mutilation and obliteration through the ordinary handling and exposure which checks might be expected to receive. Magnetic inks can be read mechanically through overstamping, pencil and ink marks, oils, greases, carbon smudges, scotch and opaque tapes, as well as other foreign substances. The inks used are as durable as any presently used in printing. This readability

factor is in itself one of the most advantageous qualities of magnetic ink.

There were several other factors that had to be considered after the selection of the language. One of these was placement of the characters on the check itself. The decision was reached to encode in a clear band measuring 5/8" across the bottom edge of the check. This was done to reduce the incidence of mutilation and provide lower equipment costs. It was also felt that bottom edge encoding would find greater customer acceptance.

What do these magnetic characters look like? How many characters are in the language itself? And how is this language used? The language consists of the ten Arabic decimal characters 0 though 9 and four special symbols or field designators called the amount symbol, which encloses the amount field, the account number symbol, for enclosing the account number field, and the ABA-Transit Routing symbol, which encloses that field. Also available are hyphens for further field separation within the account number and within the ABA-Transit Routing fields. It should be borne in mind that this language was designed to handle a special purpose application, the processing of checks and deposits.

One question which arises should be answered immediately. Can the language employ the full alphabet? The answer is: not in the immediate future. The electronic reader which interprets the characters is limited to recognition of fourteen characters. Research may some day broaden the language, but the present language is limited to a numeric code.

The encoding bank is precisely defined in terms of fields. Beginning 5/16" ± 1/16" from the right edge is the amount field, which provides for ten digits and two symbols each 1/8" wide for a total of 12/8". Next is a nineteen-digit account number and transaction code field — this field is reserved exclusively for use by the drawee bank — and finally an eleven-digit ABA-Transit Routing field. There are a total of forty-two character positions available across the check.

It should be pointed out that all present equipment is designed to meet the requirements of this language. Any revisions in the language or fields of information will necessitate machine modifications. Observe that the magnetic character itself has a highly

stylized font or type style which is designed to permit the maximum distinction between characters when read by the magnetic character reader and when a determination is made by the recognition circuits of the reader as to which character is passing the reading head.

The magnetic ink contains iron oxide particles, which are magnetized just prior to passing the reading head assembly. The result is a form of magnetic recording not dissimilar to the method of recording on magnetic tape. Each character having a distinctive type font produces a distinctive electrical signal or wave form which in actuality is a variation in voltage as the charatcer passes the read head. This wave form or voltage variation is stored temporarily in a delay line and is then analyzed by built-in recognition circuits for each of the fourteen character positions simultaneously. Only the voltage pattern distinctive to a particular recognition circuit will cause a sufficient output signal in that circuit under certain timing conditions. It is at this point that a character is recognized and decisions can be made to act on the identified character either in a sort decision or to transmit the character as an electronic pulse code to an electronic storage device. Failure to create a recognizable output signal in one of the fourteen recognition circuits causes a reject.

An increase in the number of characters in the language would increase the difficulty in obtaining distinctive wave forms and would add to the complexity and cost of the character-reading equipment. The numeric code, however, is completely sufficient for the special purpose check handling.

Let me describe briefly some of the magnetic character equipment. Let us consider first the sorter-reader, which is perhaps the device most critical to the successful operation of an automated check-handling system. This sorter-reader has been designed for a special purpose, to sort intermixed checks of varying lengths, heights, and thicknesses, and with high tolerance for mutilated documents. Specifically, it can sort paper documents varying in size from 5¼″ to 10″ long, from 2½″ to 4½″ high, and from .003″ to .007″ in thickness. Sorting uniform documents is relatively simple mechanically; the major engineering achievement here is the ability of this sorter to handle documents of varying sizes.

This sorter can pass checks at 750 per minute, or at a maximum rate of 45,000 per hour. It can make a sort decision based on a

digit, as can a tabulating sorter, or it can make a sort decision on an entire field, such as the ABA field. In other words, it can be programmed.

The sorter has twelve pockets, one of which is a reject pocket. Ten pockets are available for sorting on the digits 0 through 9. A special pocket provides for outsorting during a digital sorting pass, and checks which have no further significant numbers in an account number field are outsorted in sequence to the special pocket. This feature can greatly reduce sorter passes during digital sorting. The sorter can be used as a document sorter or as direct input to a computer. Indeed this is one of the significant features of this new language and its associated equipment. The magnetic ink character language is a new form of communication with computing devices.

Additional systems flexibility results from the ability of this sorter to be equipped with a high-speed or low-speed listing device, a paper tape punch, and a self-checking account-numbering device. It is easy to load and unload while in operation, and it is equipped with a vacuum feed-friction separation feature for positive separation of items. In addition it has an antijam mechanism, which stops the machine before a jam occurs, thus preventing document mutilation. Incidentally, it was this machine which was the major attraction at Chicago.

The next device is a magnetic character imprinter, which can be attached to a proof machine. The purpose of this device is to imprint the amount of the check in magnetic ink characters as a by-product of a required proof operation. In effect the amount imprinting is obtained without cost. This proof operation will continue to exist in banks as long as deposits are received at the tellers' windows. The imprinter itself may be attached to smaller machines, such as an adding machine, where the system only requires a listing of amounts and one or two totals. The present imprinter has two sort pockets for imprinted items, but it can be expanded. A significant fact is that the ribbons required to imprint the magnetic characters are now being made at a cost that makes the per item impression cost negligible.

Another device available is the qualification imprinter, whose sole function is to imprint missing information in either the account number or ABA-Transit Routing fields on documents

which have not been preprinted. This device can also be used to imprint new account checks.

How do bankers intend to use these devices? The primary use, of course, will be for check handling and demand deposit accounting.

In one case the amount imprinters attached to proof machines or adding machines will be grouped with a sorter-reader, which can sort the checks by account sequence, produce proof lists, punch the check, and deposit information into paper tape. This tape can then be fed into an automatic posting machine, which is equipped with a punched paper-tape reader and an automatic ledger-feeding device. All operations subsequent to the first proof-imprinting run will be fully automated, and the bank can have a full-scale automation system, which produces a fully detailed statement and ledger and a trial balance, with a minimum number of clerks. Incidentally, this machine employs another form of magnetic machine language. This language is recorded on ledgers on magnetic strips and enables information pertinent to the account to be read automatically.

In another case, the input equipment can be used with a full-scale computing system. The sorter-reader can produce punched paper tape to be read by the computer, or it can input the information from the checks and deposits directly (on-line) to the computer as they pass the sorter-reader magnetic head. A third possibility is to read the documents through the sorter-reader and convert the information to magnetic tape.

The method of input chosen will depend mainly on the volume of accounts and the item activity, as various combinations of equipment can be proposed ranging in size from 10,000 accounts to more than 110,000 accounts. It may be of interest to know that all the types of equipment which I have discussed except the automated posting machine have been delivered to the General Electric Company for use in the Erma banking system at the Bank of America in California. Full-scale operation of the first Erma system is expected early in 1959.

Another use for various units described here is in the Federal Reserve System. As you know, the Federal Reserve Banks handle the largest volume of checks in the world, and they are vitally

interested in the success of the common bank language based on magnetic ink characters. Their job is primarily a listing, proving, and sorting operation, and machines similar to those described here will make it possible for them fully to automate their check-handling operations when a sufficient saturation of encoded documents enables the equipment to be used efficiently and economically. To this end the Federal Reserve System requested proposals for the installation of pilot installations of magnetic ink equipment for sorting, listing, and proving operations. If the Federal Reserve System moves forward with this project, it will be a further positive step toward the goal of full interbank automation.

Today, except for the final decision on type font, the magnetic ink character recognition system is a reality. Hardware is in being, and in many banks plans are being made to install this new equipment. It is true that much hard work and many problems still lie ahead, but everyone associated with this program is optimistic that this "Electronic Decade" will be remembered by the bankers of this country for having produced a successful bank-automation program based on a common machine language.

Paul E. Hamman

Systems Design and Internal Control Related to Automated Data Processing

The use of automated equipment tends to place more emphasis on controls by machine rather than on controls by personnel. Human scrutiny is replaced with machine scrutiny, comparisons, and tests.

We have tended to use the electronic computer to provide the same end results as is obtained by using manual or existing machine systems. Few of the new installations have developed new data for business management or have helped provide new solutions to management problems.

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THE glamorous term "electronics" has attracted much attention in business and accounting circles during the past few years. Some of the newness and perhaps some of the glamor are disappearing. Certainly, business and government are just beginning to receive a return on their very substantial investment in equipment and the design of systems for the equipment.

Some critics have pointed out that, in the case of many users of the new equipment, the results so far have been disappointing. The results for others have been all or more than was expected. Perhaps some expected too much too soon. Many have underestimated the time and talent required to plan and prepare for electronics. There is still much to be learned about how to use effectively the full

capabilities of presently available equipment. Moreover, we can expect many new developments in the next few years.

What are the basic problems of system design in using electronic equipment? What is the effect on internal control? How does it change the work of the internal auditor or the independent accountant? These questions cover a broad area. I am going to limit my remarks to certain rather limited aspects of system design and internal control. One or two points related to auditing will be mentioned.

INTERNAL CONTROL

Internal control is not a new idea. Present concepts are the result of many years of study, experience, and trial and error. It can be observed that practices vary rather widely as between organizations. Despite the lack of newness, internal control practices are still subject to change and improvement.

One feature of adequate internal control is the segregation of duties among the employees of an organization so that no one person has complete control over an important part of a business or financial transaction and the work of each employee is checked by another employee carrying out a successive step in the same or related transaction. In this way the company's assets are protected from misuse and fraud, and reasonable accuracy of the recorded transactions and of the reports thereon is assured. The emphasis on division of duties between individual employees is particularly significant. Internal control tends to offer less protection in the event of a conspiracy to defraud. Internal control is never perfect. All practical internal control systems embody some degree of calculated risk.

It seems obvious that the use of automated equipment tends to place more emphasis on controls by machine rather than on controls by clerical personnel. We are losing some of the intelligent human scrutiny of documents and transactions and replacing it with machine scrutiny, comparisons, and tests.

NEW VIEWPOINT

It is important to recognize that a new viewpoint is required in systems design and internal control related to automated data

processing. In very few instances is it desirable to have the electronic computer perform substantially the same operations as were previously performed manually or with punched cards. We are developing, and we must give additional attention to development of, new concepts of systems design.

Many months and even years are required to plan and design systems making use of electronics equipment. Correction of basic errors in systems design is costly. The over-all problem is made more difficult because of the rather rapid obsolescence of equipment. Each morning's mail seems to bring news of new machines or periphery equipment. We must generally design systems before we can actually see the machines or develop reliable data and experience with the practical problems of their operation.

How do we develop this fresh approach and new viewpoint with respect to systems design and internal control for automated data processing? Perhaps we need to redefine our objectives. We certainly need quantitative measurements of costs and risks. Thoughtful evaluations must be made of alternative concepts, practices, and equipment.

OPERATIONS RESEARCH

In recent years scientists and mathematicians have been developing operations research, a new approach to the solution of many governmental and business problems. Although it might be argued that electronics and operations research are two separate and distinct fields, it is obvious that there is overlap. I am convinced that the viewpoint and techniques of the practitioners of operations research can help us in defining problems that need solution, in evaluating automated data-processing systems, and in measuring the advantages and disadvantages of alternative methods and concepts. For example, one of the many developing techniques of operations research is simulation. It can be used to analyze operating problems. It can be used to try out new ideas without incurring all the costs of a full-scale, on-the-line testing process. Moreover, simulation can radically reduce the time required to test a new idea or a new process.

Statistical sampling is another operations research technique that can be used in evaluating data as a basis for systems design.

It offers possibilities, for example, in measuring the amount of error to be expected in input data. We can also use sampling to measure the frequency of entry of new data in a file maintenance program.

CHARACTERISTICS OF AUTOMATED DATA PROCESSING

How do we find a new approach to traditional internal control concepts? It may be helpful to mention some of the more important characteristics of automated data processing in relation to our internal control problems in designing a system. These may be summarized as follows:

1. Centralization. Data processing tends to be centralized even though operating organizations are continued on a decentralized basis.

2. Accuracy of input data. Accuracy of input data becomes more important. Manual systems customarily operate satisfactorily despite many errors in input data. Machines generally cannot determine that data given them are incorrect or incomplete unless specifically programmed to search for errors. Checking input data in this manner with a computer is a normal procedure, but there have been practical limitations in doing this up to now.

3. Audit trail. An audit trail must generally be maintained in designing a computer system. This is needed by the internal auditor and the independent accountant. An audit trail is also generally necessary as part of the operation of the computer system itself, for example, in order to permit a reconstruction of records in the event of mishap in the operation of the computer.

4. Original documents. We can anticipate elimination of many original documents supporting transactions, or major alterations in their form and content. Changes of this sort are foreseen as a consequence of automated data processing although up to now this particular characteristic does not seem to be too important a factor.

5. Complexity. The over-all complexity of automated data-processing systems creates internal control problems. Because the clerical work in a manual system must be broken down into convenient and relatively simple segments, such a system tends to be relatively easy to analyze and understand. Combining these elements of work

and grouping them with other elements of work from related areas within an organization adds an initial degree of complexity. The large-scale electronic data-processing equipment itself is complex, and the systems associated with them are not easily understood.

WHAT KINDS OF CONTROL?

The controls related to automated data processing may be divided into two broad categories: first, those established outside the data-processing system; and second, those built into the machine or as part of the machine program.

The controls established outside the data-processing system can take many forms. Test examinations by an internal audit group are one example of an "outside" control. A separate control function staffed by personnel independent of the data-processing center is another example. Such a function can scrutinize signatures on documents authorizing transactions, maintain independent dollar or unit control totals of transactions, and perform other necessary checking or control functions with respect to input and output data.

Controls built in the machine equipment or made a part of the machine program can check the validity of part numbers or document numbers, check the status of account balances, check the apparent completeness of data, and so on.

HOW MUCH CONTROL?

It is admittedly difficult to specify just how much control is necessary in an automated data-processing system. We have always had this design problem with us under existing manual or machine systems. The basic difficulty is in measuring and evaluating the risks associated with the lack of controls. Business and government have been reluctant, and properly so, to spend $50,000 a year to prevent errors that cost $5,000.

It has been observed that most of the automated data-processing systems have tended to provide more controls than might be considered minimal. This can be expensive. It is becoming increasingly apparent that work simplification studies are just as important with an electronic computer as with any other manual or machine system. There has been some tendency to assume that the elec-

tronic machines have such a capacity for work and are so fast that not too much attention need be directed to the work load that we give them. Unfortunately, this is not true.

A practical suggestion in transferring an existing data-processing problem to an automated data-processing system, is to provide no more control or checks than previously existed. This is probably easier to say than to do because the format and the details of the two systems may be radically different. Tests and evaluations can be used, however, to validate this approach.

SYSTEMS DESIGN

Turning to systems design, I would like to develop several points — the first, about integration. By this I mean the grouping or consolidation of similar records or data. There has been a natural tendency to assume that it is always desirable to combine several existing records or files and process them as one master file in a computer. This approach has many "bear traps." One of the most important is that this may not be the "low-cost" method. It can have the effect of passing much redundant or useless information through the computer system each time the file is processed. The resulting program may be too large to store in computer memory. The processing time may be longer than would be required if two or more files were processed separately. While exploration of all of the likely alternatives in systems design and programming is time-consuming and expensive, there seems to be no other alternative if we are to develop assurance that we have the "best" system and program.

An adequate determination of "end result" requirements on the computer system is still one of the most difficult and most sophisticated problems of the systems designer. Perhaps the problem disappears when the systems designer is asked to provide the identical end result of an existing manual or machine system. Many computer systems have been installed with this as the basic approach. Frequently it is found that while the computer does provide the desired output information, the work is done no quicker or no cheaper than under the previous method. Economic justification of a computer is sometimes dependent upon designing a new end result which is equally or more satisfactory to the user than the old end result.

If new end-result requirements are to be developed, a situation is created which can utilize all the skills and talents of the scientist, the systems designer, the accountant, the auditor, and management generally. It has been observed that one of the disappointments of the "computer age" up to now has been that so few of the installations have developed new data for business management or have helped provide new solutions to management problems. It seems that we have tended to use the computer as a work horse rather than as an analyst, a planner, or a problem solver.

AUTOMATIC PROGRAMMING

Automated data-processing equipment in business or government is most commonly thought of in connection with repetitive processing of data — perhaps daily, weekly, or monthly. Less emphasis has been given to special one-time usage of the automated data-processing equipment for special problems. One practical reason for this is the time required to compile and test special programs for most computers. The time required may range from perhaps a minimum of one man-week to as much as several man-months. This tends to discourage the use of the computer for one-time problems unless a program is already available or the one-time problems are of major size or importance.

Considerable attention has recently been devoted to development of methods whereby a computer can be used to compile the details of its own program. There have been several promising approaches to this problem, generally described as automatic programming or automatic coding.

One of the more promising developments along this line is known as a "program generator" or a "report generator." The basic idea may be briefly described as follows. A large-scale computer is presumably available, and various types of record files are maintained on magnetic tape in accordance with a specified format. Assume that certain special analyses or reports are desired which are based upon the data already recorded on magnetic tapes. The desired reports presumably can be prepared from the data on file if they are properly analyzed and processed in the computer. The request for the data is set up on a specially designed form which identifies basic data required and the analyses and computations desired with respect to the data. Provision is made for the

translation of this request into a standardized punched-card form, which the computer will then analyze and for which it will prepare a program to produce the desired report or other analysis. The entire procedure — preparation of the request for a report or data, card punching, and computer time — may require no more than an hour or two.

The report-generator technique has intriguing possibilities for the business manager, the systems designer, and the auditor. A skilled programmer is not required, and the technique eliminates the need for the days or weeks of programming time. While this idea is still in a developmental state, the initial tests are reported to be very promising.

USING A COMPUTER TO DESIGN A SYSTEM

The report-generator technique is one method of using a computer to, in effect, design a system. There are other possibilities. Consider the steps that are required in designing any system. One important step in systems design is to have an adequate analysis and understanding of the data or transactions to be handled by the system. If the system involves inventory, for example, it is important to know quite a little about the nature and composition of the inventory. Stratification data are helpful. What is the relationship of the number of high-value and low-value items? What about turnover of various segments of the inventory? Lead time for replenishment should be analyzed. A great many measurements should be made. It has been frequently necessary, for practical reasons, to design systems without wholly adequate data as to the transactions or problems to be processed. Application of imagination and ingenuity can suggest many ways in which an existing computer system can be used to design better systems.

USING A COMPUTER TO IMPROVE INTERNAL CONTROL

There has been concern that centralization of data-processing activities within an organization may tend to weaken internal control. Fewer people will be in a position to identify errors.

Why not take a more positive approach to this problem? We should be able to devise economical and practical methods whereby

the computer identifies many types of errors in input data. We should be able to program the computer to provide necessary checks and controls on its own operation. We should be able to use the computer to improve internal control. This is not a new idea, but much developmental work still remains to be done along this line.

USING A COMPUTER TO MAKE BETTER AUDITS

There has also been concern that computers will make the work of auditors more difficult. Again, I suggest that we should shift the emphasis on this point. How can we use the computer to help the auditor?

The report-generator programming technique previously referred to has obvious possibilities. Auditing involves analysis of data and checking for exceptions. The auditor, for example, can ask the computer to list past-due accounts and provide an aging analysis. Slow-moving inventory can be identified for further investigation. The possibilities are endless.

TECHNICAL SKILLS

Will the increased use of electronic computers tend to displace the accountant or the auditor? I do not think so. We will always have many unsolved problems. We will have to increase our skills. We will need to know more about the management of government and business. We will probably need to know more about science and mathematics. There will be changes in the work that we do. It is likely to be more interesting.

David V. Savidge

The Development of Systems and the Application of Electronic Data Processing

Data-processing systems embrace the functions of recording transaction data, storing transaction data, converting transaction data to decision data, and producing output decision data intelligible to management. There is needed a standard language for describing problems, so that the work done by one agency or office could be utilized by any other. Regardless of the type of tool used, the same problem definition should be usable by different locations.

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FOR many years the word "account" has connoted a piece of paper. It was considered that one could not keep an account unless one had a piece of paper. As machines were developed, recording on more than one piece of paper was accomplished by the use of carbon paper. Likewise, more complicated machines were developed to do more than one thing at a time. As long as everything necessary could be accomplished in one recording, this was satisfactory. The requirements of statistical analysis for the purposes of control developed the need for processing the same data more than once. This gave the wide market for the punched card. It was necessary to store the data between processings in machine-intelligible form. The punched card by itself did not get away from the

connotation of paper, however; it only imposed certain rigid requirements on the size and form of that paper.

With the advent of electronic data processing, it is no longer necessary to keep an account on paper. It has been found that other forms of storage in machine-intelligible form are more permanent and can be sensed at higher speeds. The major impact of electronic data processing on systems development will be found to stem from this separation of accounting and paper.

Data-processing systems embrace the functions of recording transaction data, storing transaction data, converting transaction data to decision data, and producing output decision data intelligible to management. As these systems take advantage of the capabilities of electronics, we find that more and more functions are being covered by single systems. Procedures which previously required many manual interventions have been automated to an extent that, instead of referring to these systems as data-processing systems, they could well be referred to as data-mobilization systems, the idea being that any answer that anybody wants can be gotten at any time. This idea is in itself a pitfall. As long as accounting meant paper, all we needed to do was file another copy to be able to retain everything that might be needed. When we examine the archives in the acres of government warehouses, we find that much of the information stored is not only redundant but duplicated.

Electronic data processing increases the need for the accountant to determine what facts about what transactions are really significant and for how long they will remain significant. The question is no longer should we retain a particular piece of paper, but for what period of time should a certain piece of information be retained (a) in machine-intelligible form for quick access, (b) in machine-intelligible form for relatively slow access, or (c) in a form not readily intelligible by machine. The tendency at the start is to retain everything in some form. This is satisfactory, if at the same time we accumulate statistics showing the frequency of reference to each of the kinds of information stored. This can be accomplished much more readily with EDP than with other types of processing equipment. We get the indication here that the electronic data-processing equipment can provide a powerful tool in the development of systems utilizing such equipment. We can get

a feedback between the operation and the design of the system to perform that operation. Unfortunately, up to the present time, most of the companies have been too busy trying to make their installation pay off to devote much time to the development of feedback systems. We anticipate that more of this kind of work will take place in the future. The fewer the number of manual operations in any system, the more objective can be the evaluation of that system and the more effective can be our improvements. We must conclude that as of today we have barely scratched the surface of systems development work just as most of us are agreed that we have barely scratched the surface in hardware development.

Electronic data-processing equipment is becoming faster and smaller. The ultimate limit is the shortest length into which a piece of wire can be made; in other words, the smallest possible connection that can be made between two components. This will control both speed and size. Equipment that processes punched cards can employ wiring units and plugboards to adapt the individual piece to a particular job. As these units become smaller and faster, the requirement for effective contacts with very fine tolerances increases to the point where we can no longer use devices which are set manually. This imposes the requirement that our problem definitions become more specific and the problems themselves less susceptible to change. This requirement goes hand in hand with the one previously mentioned, that it is the accountant's responsibility to determine the relative significance of the information within the system. It becomes obvious that a stable system can only be developed after the significance of the information has been determined. This, in turn, will facilitate the utilization of the most powerful tools.

An examination of the present installations of EDP indicates that they can be grouped into four major categories. First, we consider those installations which handle single applications for single customers. In this category are applications such as the Social Security installation in Baltimore and the check-reconciliation job of the Treasury Department. There are not too many jobs of this size within the federal government. Within the installations of the Air Materiel Command of the U.S. Air Force, we find a tendency to perform different applications for single customers. Within one

depot the installation is intended to perform a variety of functions for that depot. The Bureau of Ships at the David W. Taylor Model Basin is an example of the execution of different applications for different customers on a single installation. In this instance, the application is assigned to the installation, based on some evaluation of the total work load represented by the application. The most recent break-through in the development of applications is the study currently under way by the Army for the installation of EDP at Class I installations. This is the lowest level within the Army's chain of records. Here the same applications are intended to be performed for different customers, as represented by the different Technical Services, which are lesser organizations within a Class I installation.

Each of these four classes of EDP installations poses the same problem of translating the specifications of the job to be done in machine-intelligible form, so that the tool to be used can understand what it is supposed to do. The people with the problems must be able to communicate with the people who have the machine, and if the people with the machine have more than one kind of machine, the communication problem is multiplied. In the final analysis, however, this places the same requirement on the accountant that is placed by the storage problem. It is necessary to develop a set of rules for describing information which is concerned only with the characteristics of the data. In other words, the rules do not care whether the data is represented by a round hole, a square hole, printed characters, or a series of magnetic dots. Another set of terms must be used to describe what is done with that data. This latter set concerns itself with the manipulations on the data itself and not on the unit in which the data is stored.

This is another way of saying that, due to the number of different jobs to be performed on so many different kinds of equipment, it is extremely important that we start with a statement of the problem in such terms that anyone can relate it to any kind of equipment and that anyone can make changes to it at any later date. Accountants engaged in systems-development work have been developing a degree of standardization in representation for a number of years. We now have a new factor which should give added impetus to the movement. We must be able to describe the

inventory of the data to be processed and the inventory of the processes to be used in basic English which does not include any of the colloquialisms of an individual agency or application.

An inventory of data can start with the establishment of the distinction between a set of data and an element of data. The two terms "element" and "set" are used in the calculus to denote an individual item and a collection of similar items. For the purposes of distinguishing between elements and sets of data, however, we must further define these two terms so that an element of data is recognized as a unit of data of which all parts receive identical processing. In other words, a stock number is an element because we compare a complete stock number with another stock number. A name and address can be treated as an element of data if all we want to do is copy the name and address onto some other media. A set of data, by contrast, consists of a group of elements which have at least one characteristic in common, whether this be time, place, or identity. The journal of all of the transactions taking place in one day can be treated as a set of data. The punched card reflecting all the details of a particular transaction can also be treated as a set of data. A file of all of the punched cards relating to a particular stock number can be considered as a set of data. An inventory of this data can be secured by listing all documents handled as sets and indicating all the elements appearing on every document. If this inventory is displayed on a grid chart with the elements listed on the left and the sets indicated above the columns so that every row represents an element and every column represents a set, a check mark placed in a column on a line represents an element which appears in that set. This can provide a graphic picture of the presence or absence of particular elements in each set. We have noted that, where this procedure is followed, the development of a new system is started as soon as a check mark is made on the grid chart. Duplications of data become obvious. This is especially true if an attempt is made to integrate all the data processing and determine where the same data is used by different organization units for different purposes.

The inventory of the process is accomplished on another grid chart of the type described in Department of the Army Pamphlet 1-250-1, entitled "Automatic Data Processing Systems (Business

Type Operations): The Conduct of ADPS Feasibility Studies," where the sets of data which are inputs are listed to the left of the grid chart as line captions and the sets of data which are outputs as the column headings. A check mark in a square indicates that the set of data listed in that line is an input required to prepare the output indicated by the column. When this is done for different functions, the need for further revision in the existing system becomes apparent. It will be noted that certain documents or sets which are produced from source documents will themselves become inputs for the preparation of final reports. This injects a basis for classification of the sets of data. We consider that sets of data can be of three types: (1) source documents which are always used as inputs and are never outputs of this system, (2) sets of data which are produced by the system and are later fed back in as inputs, and (3) sets of data which are produced by the system and are never fed back into the system. No set of the first class will appear as a column heading on this grid chart. No set of the third class will appear as a line caption.

If this method is used to inventory the process of the present system, particular attention needs to be paid to the flow of these intermediate results, the sets of data which are produced by the system and later fed back into the system. If it is obvious that some of the source documents used to produce an intermediate result are used in conjunction with it to produce a final result, the question immediately arises as to why the intermediate result did not carry forward such information as to produce the final product.

It will be noted that throughout these two stages we are concerned with two identities, those of elements and those of sets of data. Questions of volume, tools used, and the like have no bearing on the development of the initial inventory. We have, in effect, developed a road map for spelling out the complete process within the applications to be studied. For every check mark on the inventory of processes it is possible to describe the sequence of operations on the sets of data to go from the inputs to the outputs by using the following verbs: test, post, copy, erase, sort, and file.

It will be noted that these verbs are similar to the verbs used in work simplification studies — in fact, up to this point, there is very little difference between this technique and those propounded in

the various texts on work simplification. This becomes the point of departure. When we examine these six verbs, we find that only two really make any contribution to the data processing as such, those are test and post. We find that to go from any input to any output we must first test the data in the input set to determine if this set is acceptable for processing, and then, secondly, we post the data. Since data processing involves for the most part the storage and communication of data, we describe these functions as posting.

The other four verbs, whether they are used or not, and the amount of effort expended in performing these actions, are functions of the tool used and the number of items to be processed in a given period of time. If we have only two pieces of paper covering the same kind of transaction, we will do something entirely different than if we have one hundred. The question of how much work must be done has no great effect on the logic of the process even though it has a major effect on the selection of the tools to be used. We consider, when dealing with an electronic data-processing system, that it is best to defer any of the questions which relate to a particular kind of equipment until after the description of the data process has been completed. Failure to abide by this rule only hampers the development of a satisfactory system.

Analysis of the operations performed on elements of data to accomplish the actions of test and post indicates that any test or post action can be described in detail by using the following verbs:

Arithmetic actions — add, subtract, multiply, and divide.

Logical actions — compare and ignore.

Documentation actions — record, copy, and erase.

A step-by-step description of the entire process leading from an element of data in an input set to an element of data in an output set can be described by using these verbs. It is interesting to note that, while these verbs are used in work simplification studies, they are also used in the programming of electronic data-processing systems. It seems logical, therefore, that if these terms are used to describe a problem, it will be much easier to develop a solution of that problem than if some colloquial terms peculiar to an office are used.

The Federal Government Accountants Association, representing the accounting profession in all agencies of the federal government,

which is the largest single processor of data in the world, could actively investigate the possibility of developing such standard language for describing problems, so that the work done by one agency or office can be utilized by any other, and so that, regardless of the type of tool used, the same problem definition can be used.

The development of standard practices for the representation of problems and solutions is as necessary today in the field of data processing as it was in the field of mathematics many years ago. Some organization outside the computing field should initiate such a movement. The language of mathematics was developed without the benefit of computers. It was developed by the users of computing tools. The language of data processing should be developed by the users of data-processing tools. Accountants, and federal government accountants in particular, are in that category. If the largest business adopts a set of standard definitions and terms, the rest of business will soon follow.

Kenneth C. Tiffany

The Economic Impact of Electronic Data Processing

The economic impact of electronic data processing has been less than the optimistic forecasts, but the forecasts for the future are more promising than ever. Direct cost and labor savings have not materialized as anticipated, but systems have been streamlined and integrated. One of the areas of greatest potential profit is "Operations Research."

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IF any subject requires straight talk in business today, it is the economic impact of electronic data processing. Electronic data processing is still an enigma on the business scene. Of the 1,700 medium- and large-scale computers at work, no more than 100 have had two full years of use. Cost data are scarce, knowledge is thin, and "economic impact" is frankly hard to assess. This has not discouraged EDP, like any precocious child, from developing a dogma all its own. As a result, when you discuss computer economics, many businessmen are understandably more confused than a myna bird at a Berlitz school.

As you know, computers first sparked management imagination with the Census Bureau's installation in 1951. The press fell in love immediately. There were not enough adjectives to describe a superbrain which could shuffle numbers faster than 100 calculators, pour out statistics on everything from drugs to diapers, and

solve mile-long equations. These headlines of computer journalism read today like the other scoops of the period, titled, for example, "I Rode in a Flying Saucer." Yet they enchanted many managers. Today's management, along with the press, have sobered considerably. There is even some pessimism in this headline from the *Wall Street Journal* last spring: "Computer Glamor Wears Thin; Firms Find Savings Disappointing."

The irony is that 1958 — automation's biggest year in terms of computers installed at productive jobs — is also its first big crisis in confidence. To some extent, this crisis echoes the times. Our national mood for the past twelve months has been one of disillusion — caused by the sputniks, by the economic downturn, by the revolt against conformism and groupism and team psychology and many other values which we once blindly accepted. Only this can fully explain the lessening in computer interest, so powerful through 1956. The fact the EDP was once highly ballyhooed has made it a tempting target for criticism. In a self-analytical spirit, certain former advocates are jumping off band wagons as fast as they once jumped on. They have shed their former cockiness about computers. A few have even replaced the follow-the-leader idea with an equally pernicious doctrine, "stay-in-the-rearism." Where two years ago many companies bought automation for the thrill alone, some others are now scorning the whole idea as overrated and economically treacherous. In other words, who needs it?

What accounts for all this apparent grief? The consensus suggests there has been overselling, overexpectation of fast results, and underestimation of the task of putting computers to work. Many managements pinned their hopes on a piece of hardware, rather than on the best over-all pattern for their clerical operations. In almost every case, this delusion led to disappointment. Some have persisted in looking at the computer as a superclerk rather than a new instrument for increasing the productivity of capital. Others have tried to force feed the new technology through old, depleted, senile systems which invariably choked up.

But the computer moon is not all dark. There is a bright side, too. Evidence of this is the fact that few computer installations have been actually abandoned. While faced with the worst profit squeeze in history, management seems resolved to stick with EDP. The

rude awakening has had a very salutary result — in correcting myopia and pinpointing the real benefits of automation. Managers demand to be *shown* now, Missouri-fashion, as never before. Let us then take a look at the record.

At this crossroads of 1958, the computer industry is billing close to $400-million annually. This could reach $1 billion by 1961. Computers have had the biggest economic impact on their suppliers. They have given a shot in the arm to business machines firms and have opened new jobs for engineers, mathematicians, and assemblers. They have catalyzed the electronics industry overall, which went from $4 billion to $13 billion in one decade. To date, roughly 250 large-scale, 1,300 medium-scale, and 600 small-scale digital computers have been delivered. I count only the general-purpose, internally programmed type in this breakdown. The largest machines run to several million dollars; the smallest are in the five-figure bracket.

Thirty-five per cent of all medium- and large-scale computer installations belong to the federal government, which must process some 25 billion pieces of paper each year. As of last December the government had 121 computer systems, representing a yearly rental of $20 million and a purchase outlay of $9 million.

Next in the computer hierarchy are insurance companies and utilities, with 25 per cent of all installations. Another 25 per cent goes to manufacturing. Chemicals, food, petroleum and primary metals are cut-to-fit prospects, having the largest payroll, accounting, and research. The remaining computers find themselves in the service organizations and schools.

MOTIVATION BEHIND EQUIPMENT PURCHASES

Why did these diverse customers buy computers in the first place? What did they hope to gain? There seem to be four main motives: (1) to reduce clerical costs; (2) to optimize management control through fast, centralized reporting; (3) to minimize expense and maximize profits through operations research; and (4) to keep up with the Joneses.

Excluding reason number 4, a good many companies have cashed in on all these objectives. A major defense supplier, for instance, installed a computer in payroll and manufacturing control. As a by-product, it was able to secure payment from the government

one week sooner, cutting capital needs by a substantial amount and paying off start-up costs at once.

In the parts division of a large automobile company, a computer controls inventories for various outlying depots. This firm converted from hand posting to machine accounting in one jump. Despite initial bumps in the data flow, it has achieved huge inventory reductions, with commensurate cuts in the cost of insurance, storage space, obsolescence losses, and interest on investment.

Another firm had a work-in-process inventory of $10 million. By lowering carrying costs 10 per cent, a computer saved $200,000. The same company's labor bill ran $6 million a year, with performance around 60 per cent of standard. Through timely machine-load scheduling, the computer allowed foremen to avoid duplicate setups and halve the delay for men and machines. This boosted labor performance 30 per cent, saved the company $1 million.

These successes didn't just happen — through luck, accident, or providence. They were *planned* victories. And the lesson they teach is a touchstone in computer economics. With the exception of mass-volume utility accounting or insurance premium billing, no *one* application can carry the cost of a big computer. The price tag forbids such a luxury.

More than half the users whose computers "backfired" seem to have missed this lesson. Usually, they fell into a trap baited by that modern Lucifer called "laborsaving." It is well known that management suffers from a glut of business paper work and a hunger for productive workers. No one would deny that automation offers strong medicine for these ailments. And yet, of all reasons to buy a computer, laborsaving is often the worst. The simple truth is that you cannot equate machine time with clerical effort. It usually takes far too many displaced clerks to amortize a computer.

The false god of laborsaving has two dark angels in attendance. One is called "speed," the other "hardware." They are close enough to be Siamese twins. Speed first attracted the drumfire of publicity to computers. Management quickly saw that a machine adding 300,000 numbers per minute would accelerate accounting tremendously. But they neglected to ask: speed for what? They forgot the old Army saying of "hurry up and wait." And they failed to reckon with the cost of such speed relative to total business expense.

Take a report which once consumed fifteen hours of pen-and-

ink labor. A computer can knock this down to fifteen minutes. Only an imbecile would refuse the profit gravy in such a reduction — about 98 per cent, if my calculations are correct. But it happens that this report makes barely a blip in a six-month business cycle, involving hundreds of other feeder operations. These are not touched by the computer. As a result, your 98 per cent timesaving shows up in just one manifestation — more expense.

As you will recall, the "giant brains" enjoyed the biggest early vogue, thanks to their speed. Yet, they also account for the biggest share of disappointment. You can count the number of self-supporting giants on one hand. A large computer which costs five times the medium system may well be ten times as fast. But if you let it loaf, its ravenous appetite for cash can cause a net loss on an operation for which slower, less costly equipment would show a profit. Many companies have to sweat to keep their giants busy. One can frequently rent unused computer time from customers at lower rates than from the manufacturer's service bureau. Such is the penalty of too much fascination with speed.

Too much fascination with hardware is equally disastrous. This fallacy leads you to superimpose a particular piece of equipment on existing procedures, without otherwise changing your approach. You wind up with small islands of automation, which cause eddies but no new channeling of the information stream. In the early days, companies eager to start on a computer program picked their hardware first, then fitted it to their system. Considering the penalty of a poor choice, this gamble was fantastic. But more important, it demoted to second place what should be the first goal of any EDP system — to exploit its capabilities for work which could not be done without it.

Payroll best illustrates this, as it is usually the computer's first business application. Being already mechanized and well-disciplined, the job can be painlessly switched to electronics. But most users who made the switch regarded the computer as just a faster tabulator. They assumed that a one-to-one replacement would save costs in proportion to speed. Their arithmetic was unfortunately way off. I heard of a company which over the years bought every piece of equipment produced by a tabulating machine supplier. It progressed from calculators to punch-cards to a medium-sized

computer. Since these machines were all compatible, they seemed to require no changes in procedures. One day the controller examined the expense statement. He found the computer had upped department costs more than $4,000 a month over the original system. It took one year of study and some $50,000 in wasted rentals to justify this machine through added applications.

The hardware spook is very much alive. It may even haunt companies most sophisticated in their realization that you can only justify a computer when you plan for it. Planning, of course, usually produces the greatest economies of all. In preparing for a computer, one company found it had 3,000 more forms than it needed. Another saved the entire annual cost of a machine before delivery; the charmed word "computer" opened management doors locked to systems people for years and inspired sweeping changes. In some cases, these preparatory savings will convince a company it does not need the computer it has been preparing for — an economic impact with no hardware changing hands, so to speak. We hate to lose an order, but such a decision may make sense. However, if the customer's original study has been predicated on a particular piece of hardware, he is still attacking the problem backwards. His concern should first have been in devising the best new system possible and then fitting in equipment to implement it.

THE SYSTEMS APPROACH

What about this "systems approach"? Let me explore it with you. For the economic impact of electronic data processing clearly begins and ends right here.

The first industrial revolution introduced the concept of division of labor. The second industrial revolution must introduce another concept — the consolidation of management. With the complexity of modern business, management has not only grown but has also grown apart. Some means must be found to reintegrate separate operations, to centralize control, and to clarify the management job if we are to progress.

This can be summed up as the "total systems" approach. It involves the automation of decision, management's basic function, and information, management's basic medium of exchange. Management control has become increasingly dependent on informa-

tion flow through an organization. The manager rarely observes performance; his only direct link is through written reports. And these have mushroomed both in volume and obscurity. One manager compared them to daily newspapers "printed without headlines or punctuation, without spacing between lines, and without capital letters."

Even the smallest computer installations can help break this paper blockade. But the big payout will come through computer systems spanning the entire cycle of data transmittal — from point of origin to final filing. All segments of a company operation can be viewed as a functional whole, whose various information centers are monitored and linked through computers. Data at one point will be generated as by-products of data at other points. Office and factory will be so tied together that information can be fed directly from production through computers and back to production in an automatic closed-loop network.

Consider the processing of a sales transaction. When handled through a computer system, this single job could bring about action relative to credit, accounts receivable, billing, sales distribution, and commissions. Properly coded, the same transaction could effect changes in production planning, receiving, shipping, and inventory control — all in one automatic pass of the machine.

The mechanics of sorting, file storage, and information look-up have always required special departments to handle them. Under an integrated system such as I have described, these divisions of functions disappear. And at this point, the real economic impact of EDP will be felt.

I am happy to say that the government has trail blazed this frontier. In some agencies — notably defense — closely related jobs have been coalesced into a single automatic system. As you perhaps know, the government is deep in research in one of the most sensitive areas of office automation. This involves producing data in machine-sensible form as close to the source as possible. Ideally, documents would be prepared by the same system which later receives them, such as public utility bills, sent out on prepunched cards and returned with checks for the correct amount. Much has already been accomplished toward recording information in computer-language at the point of origin. The Census Bureau has

developed a device which transcribes raw data from microfilm to magnetic tape for electronic processing. Burroughs electronic bookkeeping machines are fitted with attachments which punch computer input-tapes as a by-product of tabulation. Magnetic character-reading equipment now is becoming available in the banking field. All these hold high promise for the ultimate impact of the "total systems" approach.

But this approach cannot succeed through technology alone. It requires as its seedbed a whole new management attitude. It insists that management not only judge hardware and speed, the bells and whistles of automation, but also start "thinking systems."

The most cogent line of attack is to determine first what information management really needs and how fast. At this basic level, we analyze the whole work flow of the office — decide what end results are desired, what quantity of raw data must be produced, and how to circulate this data most cheaply through a pattern of related steps. Jobs can then be priority-rated according to their most immediate pay-out through EDP. These clues tell us what kind of computer we must have, what peripheral equipment must go with it, and what operating characteristics — speed, capacity, flexibility — must be gotten for your money. Systems design applies equally to the plant, to logistics, and to the clerical processing line. But you must do it *first*, before you select your machine. Had everyone done so, there would be even less talk of "disappointment" today.

Once your system is installed, however, how do you measure its economic impact? What are the bench marks of progress? As indicated, dollar yardsticks are both deceptive and scarce. The plan-versus-performance approach is tricky also, since you may be matching a bad plan by an equally bad performance. There is no single answer to this problem. Each company must develop its own criteria in the light of the systems approach. One retailer, for instance, uses a computer to profile sales movement continuously. It yields no direct savings. But management values its ability to exploit seasonal markets and minimize lost sales due to empty shelves. The Navy uses time as its standard, recognizing that money can buy more men and weapons, but never more yesterday. Wasted time becomes an index to poor organization, revealed through red tape,

garbled communications, duplicated effort. If a computer cuts this waste — by better allocating resources, streamlining procurement, optimizing combat support — it is judged worthwhile.

This problem of economic impact has bedrock importance in at least two other areas. One is operations research; the other is the manner in which computers are acquired. I will touch just lightly on each.

OPERATIONS RESEARCH

As you well know, operations research has promised the most dazzling returns from electronic data processing. Since its conception in World War II — as a tactical defense for Allied convoys against German submarines — this new "decision strategy" has taken management by storm. Fifty-one per cent of the companies canvassed by the American Management Association are using some brand of OR; another 25 per cent plan to start in the near future.

The attraction is obvious, OR solves problems for which no clear-cut decisions are at ready hand — problems of business variables. With computer mathematics as a crystallizer, OR tells management where to employ its capital under varying circumstances, over what routes to ship goods from outlying plants, when to push products in different areas under different circumstances. It gives business greater mobility and responsiveness to changing conditions than ever before.

But management science is no insurance for decision makers. Results, as one person put it, "depend on what we do to things we can control and knowing what may happen to things we can't." Frequently, the true value lies not in the answers at all but in the questions asked. For if it does nothing else, OR causes an analysis of accepted policies and assumptions. This new technique almost always requires a computer and is therefore expensive. Before undertaking a "management mathematics" program, you must clearly define your goals and know what they are worth.

OBSOLESCENCE OF EQUIPMENT

Obsolescence is one of the demons to be exorcised in EDP thinking before we can look for the fullest economic impact. This word,

after all, can only mean one of two things: (1) either the equipment is no longer needed; or (2) it has been outmoded by newer technology. The user must bear some responsibility in the first instance. If he plans his system for a long enough period it can never become procedurally obsolete. The second and more common bogey — technological obsolescence — has real significance only on one occasion. That is when newer equipment appears which is so much faster and more efficient than the old that it permits a tremendous increase in cost recovery. I use "tremendous" advisedly, cognizant of the major investment in systems work, programming, physical installations, and conversion which each new computer involves. Studies of all announced techniques for computer construction indicate it will be from seven to ten years before such major economic improvements are on the market.

For some customers, obsolescence jitters are a mental block to getting a computer at all. They prefer to wait for the "ultimate machine." It is well known that every aggressive supplier has computers on the drawing board. But it is equally known that you can never handle a current work load with a drawing-board machine. There will always be an "ultimate computer" in some design engineer's mind, and thank heaven for that. But not until it takes form in metal and circuitry and is delivered to the user's office can tangible results be counted in its favor.

SUMMARY

On all these fronts, the task of winning greater economic gains is shared by both suppliers and users of EDP equipment. As the bigger user, the government must naturally set the pace. Its record so far is excellent. The Navy has developed a five-year blueprint for integrated data processing. The Army has under way an EDP program of heroic proportions, looking toward a world-wide digital communications system for tactical and logistic support. The armed forces have been first to indict the "hardware" approach, and to rebuke manufacturers for not proposing equipment which will solve specific military problems. Bad answers from industry, in fact, have caused a slight rift in the buyer-seller relationship with government.

I would urge the government to set an even more ambitious

pace in the future. As the country's biggest enterprise, it has the biggest data-processing problem. This does not mean the dollar sign can be ignored. But government has the financial leverage to exploit EDP equipment on a grand scale, to strike out into the no man's land of automation and capture its fullest benefits.

In summary, the economic impact of electronic data processing to date has been (1) less than some expected, but (2) more promising for the future than ever. Direct cost and laborsavings have not materialized as anticipated. The chief economies have been and will continue to be in systems streamlining and integration. We are just beginning to see real substance in the approach known as "operations research."

I am convinced that government, working with industry, will turn this electronic revolution to truly revolutionary account. It has both the need and the resources to build from the few ashes of disappointment which may lie about.

Herschel C. Walling

Technical Accounting Developments

ACCRUED EXPENDITURE LIMITATIONS

THE Director of the Bureau of the Budget, Maurice H. Stans, prepared a short statement for the *Journal of Accountancy* on Public Law 85-759, an act to provide for improved methods of stating budget estimates. His statement was quoted in an editorial in the October 1958 issue (vol. 106, p. 36).

Mr. Stans expressed the view that this legislation will strengthen the hands of both the Congress and the executive branch in controlling federal expenditures. He pointed out that it will require positive review and action to be taken each year on the scope of annual programs through the establishment of an accrued expenditure limitation in each appropriation and should, among other things, bring about more cost consciousness and assist in an effort to get maximum value for each tax dollar. He also stated that the legislation will be implemented on a gradual basis, starting with a few appropriations in the 1960 budget, because a major change such as this cannot be applied overnight to the far-flung and diversified programs of the federal government.

ESTIMATES OF BUDGET EXPENDITURES AND EMPLOYMENT

The Bureau of the Budget has issued instructions and guidelines for the preparation and submission to the Bureau by most of the

executive agencies of periodic estimates of budget expenditures and employment, called a "summary financial plan," and of related reports on budget progress, to be used in reporting to the President (Circular No. A-24, October 1, 1958).

Each agency will submit a "summary financial plan" twice yearly, estimating budget expenditures and employment by months. Each agency will also submit progress reports related to its financial plan. Certain agencies will report monthly and others quarterly. In these reports the agencies will evaluate their actual performance in relation to their financial plans and explain major deviations, so as to provide information on their current budgetary position and budgetary results to be expected for the full year.

COSTS UNDER GOVERNMENT CONTRACTS

The report of the Senate Committee on Appropriations on the Department of Defense Appropriation Bill, 1959 (S. Rept. 1937, 85th Congress) expressed the Committee's concern over rising costs under government contracts, as follows:

Defense Contracts

The Senate committee is gravely concerned over the inability of the Government, notably the Department of Defense, to provide a checkrein on increasing costs of contracts with private industry. It is recognized that in a period of generally rising prices, increased costs are inevitable. However, there is considerable substantiation to the belief that there is little incentive to private industry to hold down spiraling defense contracts. Automatic accessions to labor demands are made by industry, knowing that these increases will not require absorption but will be passed on to the Government and thence to the taxpayer. The pirating of technical employees and skilled workmen has been much publicized, the cost of which ultimately is absorbed in Government contracts. The general lack of a pressing need for economical production, once competitive marketing is removed, is inimical to the public interest, and weakens our defense armor. Admittedly, these problems have no ready solution. However, the committee admonishes the Department of Defense to study the problem, to take steps to provide a solution, and to report the results of such action to the committee not later than January 15, 1959 [p. 22].

ALLOWABLE COSTS OF RESEARCH AND DEVELOPMENT

Principles for costing research and development under grants and contracts with educational institutions have been set forth by the Bureau of the Budget in its Circular No. A-21, dated September 10, 1958. All federal agencies that sponsor research and development work at educational institutions are requested to apply these principles and related policy guides to the fullest extent practicable in determining the amounts to be authorized under grants or contracts for such work and in developing budget estimates therefor. These principles and guides were developed by an interagency committee and were reviewed by the several agencies concerned and by various groups representing the educational institutions.

It is the intent of the principles set forth in the Circular to provide government agencies and educational institutions with a common basis for determining the allowable costs of research sponsored by the federal government. Application of these principles should enable agencies and institutions to identify the allowable direct costs of such research, plus the allocable portion of the allowable indirect costs, less applicable credits. The tests of allowability of costs applied in these principles are reasonableness and allocability under consistently applied generally accepted cost accounting principles and practices; however, these provisions are subject to any limitations as to types or amounts of costs set forth in the research agreement.

These principles do not attempt to identify the circumstances or dictate the extent of agency and institution participation in the financing of a particular research and development project, but rather are confined to the subject of cost determination. The Circular recognizes that arrangements concerning financial participation are properly the subject of negotiation between the particular agency and the educational institution concerned.

FEDERAL CATALOG SYSTEM

The General Services Administration has established a Federal Catalog System and prescribed the policies and procedures govern-

ing the cataloging of items of personal property procured by federal agencies. The Federal Catalog System provides for the uniform identification of commodities by item name, description, classification, and numbering (Section 302.00, Chapter VI, Title 1, Regulations of the General Services Administration).

The Cataloging Division, Armed Forces Supply Support Center, Department of Defense, in co-ordination with the General Services Administration, is responsible for preparation of the cataloging handbooks and manuals which comprise the cataloging tools. Several basic cataloging handbooks and manuals are available for purchase from the Government Printing Office. Guides are available from the General Services Administration which set forth the procedures by which manufacturers and suppliers may furnish the federal government at time of procurement with item identification data for the items being supplied. The four-digit federal supply classification code number and the seven-digit federal item identification number assigned to a supply item becomes the federal stock number for use in inter- and intra-agency supply operations.

PURCHASING AND SPECIFICATIONS DIRECTORY

The Small Business Administration has prepared, in co-operation with the major federal government purchasing agencies, a U.S. Government Purchasing and Specifications Directory. It contains information on the government's purchasing procedures, a system of specifications and a listing of major items and services bought by the military and civilian agencies, and the purchasing offices which buy them. The pamphlet may be obtained from the U.S. Government Printing Office (Catalog No. SBA 1.13/3:958, 55 cents).

CO-ORDINATED CIVIL SERVICE EXAMINING PROGRAM

The Civil Service Commission has announced a new co-ordinated examining program for filling top-level (GS-13, 14, and 15) administrative and management positions (Departmental Circular No. 174, September 17, 1958).

Registers established under Examination Announcement No.

167 will be used to fill such positions throughout the United States and overseas in various occupational categories. Applications will be rated initially as eligible or ineligible only, without numerical ratings. When a request is received for eligibles to fill a position, the Commission will establish the qualification requirements for the vacancy and furnish a list of eligibles ranked in the order of their relative qualifications for that position. Mechanical equipment will be used to speed the identification of qualified applicants on the register.

When it appears that adequate competition cannot be achieved through consideration of applicants who have filed under the announcement, special publicity may be issued to invite applications for the particular positions to be filled.

TRAVEL AND MOVING EXPENSES OF NEW APPOINTEES

Public Law 85-749, approved August 25, 1958, authorizes federal agencies, under regulations prescribed by the President, to pay the travel and transportation expenses to first-duty stations in the continental United States of new appointees to positions in the natural and mathematical sciences, engineering and architectural fields, and to related technical positions when the Civil Service Commission finds that a manpower shortage exists in these fields and that the skills are critical to the national security effort. New appointees receiving travel and moving expenses must agree to remain in the federal service for twelve months following their appointment.

This legislation was proposed by the Civil Service Commission as a means of increasing the ability of federal agencies to recruit qualified persons in shortage occupations. The Commission has requested the agencies to keep appropriate records of operations under this law, including cost figures, for its use in reporting to Congress on the operation of the law (Departmental Circular No. 971, September 5, 1958).

COSTS OF TRAINING PROGRAMS

Bureau of the Budget Bulletin No. 59-4, November 3, 1958, prescribes regulations with respect to the absorption of costs of training under the Government Employees Training Act of 1958 (P.L.

85-507) from the respective applicable appropriations or funds. The bulletin states that agencies will be expected to give a high priority to training programs in distributing available funds and other agency resources and that the benefits to be obtained from the Training Act should offer ample incentive for absorption of the costs of the training.

CAREER SERVICE PROGRAM

The Civil Service Commission has recently established a Career Service Program to assist agencies in filling top supervisory positions by the transfer of qualified personnel from other agencies. A government-wide budget roster, which will cover accountants in the GS-510 series, is being prepared.

INDUSTRIAL FUND REGULATIONS

The Department of Defense has revised its Regulations Governing Industrial Fund Operations. There are now about 139 industrial and commercial-type activities financed under the industrial fund, established by the National Security Act Amendments of 1949 (P.L. 216, 81st Congress).

The revision of the regulations provides more extensive guidance as to principles and policies relating to operations, especially in the area of buyer-seller relationships between ordering activities and industrial-fund activities on a quasi-contractual basis and in increased emphasis and attention to the use of modern methods of cost accounting.

AERONAUTICS AND SPACE AGENCY

A new National Aeronautics and Space Administration was established by Public Law 85-568, approved July 29, 1958, succeeding the National Advisory Committee for Aeronautics. The functions of the Administration are to plan, direct, and conduct aeronautical and space activities; arrange for participation by the scientific community in planning scientific measurements and observations to be made through the use of aeronautical and space vehicles, and conduct or arrange for the conduct of such measurements and observations; and provide for the widest practicable

and appropriate dissemination of information concerning its activities and the results thereof.

FEDERAL AVIATION AGENCY

The Federal Aviation Act of 1958 (P.L. 85-726, August 23, 1958) continued the Civil Aeronautics Board as an agency and created a Federal Aviation Agency to provide for the regulation and promotion of civil aviation and the safe and efficient use of the airspace by both civil and military aircraft. The Federal Aviation Agency is an independent establishment, succeeding the Civil Aeronautics Administration of the Department of Commerce and the Airways Modernization Board.

BUDGETING AND ACCOUNTING FOR FURNITURE

At the request of the Bureau of the Budget and with the concurrence of the General Accounting Office, the General Services Administration notified the federal agencies, for which furniture and furnishings have been provided by GSA, of a change in budgeting for such requirements beginning with the fiscal year 1960. Each agency, unless otherwise provided by statute, will budget for its own furniture requirements at all locations, except for new buildings to be constructed by the GSA through lease-purchase or other arrangements. The GSA will continue to supply furniture until the end of fiscal year 1959 to agencies occupying space in government-owned, GSA-controlled buildings outside the District of Columbia and adjacent areas. For the fiscal year 1960, the GSA will provide in its budget estimate only for its own furniture requirements and for furniture in the new buildings expected to be completed during the year.

In accordance with this plan, the accounting and accountability for furniture previously supplied by GSA to tenant agencies in GSA-controlled buildings outside the Washington area are to be transferred to the tenant agencies. The procedures for this transfer are prescribed in GSA Circular No. 169, "Transfer of Furniture Accountability," dated November 14, 1958. The transfer is to be made without reimbursement. It is to be completed by April 30, 1959.

GSA will retain responsibility for the movement of furniture. Custody and accountability for furniture previously used by the moving agency or unit and not moved to the new space will pass to the GSA without reimbursement, except for trust fund furniture. When the furniture is reassigned, custody and accountability therefor will be transferred to the using agency.

Each executive agency is responsible for maintaining adequate inventory controls and accountability systems for the property under its control, in accordance with the provisions of Section 202(b) of the Federal Property and Administrative Services Act of 1949 and the General Accounting Office Policy and Procedures Manual (2 GAO 1270).

H. Edward Breen

Current Publications

BOOKS AND PAMPHLETS

American Institute of Certified Public Accountants. *Accounting Trends and Techniques.* Eleventh Annual Survey by the Research Department of the American Institute of Certified Public Accountants. New York: The Institute, 1958. 259 pp. $15.00.

This is a comprehensive study of the accounting aspects of financial reports issued annually by 600 industrial and commercial corporations.

The latest edition is completely new and up to date and is based on a thorough analysis of 600 financial statements plus an informal review of 500 additional reports, all published during 1957–1958 by corporations of varying sizes in a wide variety of industries.

The book contains approximately a thousand illustrations from these reports and will enable the user to determine the exact terminology, forms, and techniques used in today's financial statements and auditor's reports. The cumulative study will give the reader the significant trends that have been developing over the past twelve years.

American Institute of Certified Public Accountants, Committee on Accounting Procedure. *Contingencies.* (Accounting Research Bulletin No. 50, Oct. 1958.) 4 pp. $0.25.

The Committee defines a contingency as an existing condition, situation, or loss of an asset, or the incurrence or avoidance of a liability, usually with the concurrence of a gain or loss.

"The contingencies with which this bulletin is primarily concerned are those in which the outcome is not sufficiently predictable to permit recording in the accounts, but in which there is a reasonable possibility of an outcome which might materially affect financial position or results of operation." The Committee states that disclosure of con-

tingencies described above should be made in financial statements or in notes thereto.

American Institute of Certified Public Accountants, Committee on Auditing Procedure. *Scope of the Independent Auditor's Review of Internal Control.* (Auditing Procedure Bulletin No. 29, Oct. 1958.) 4 pp. $0.25.

"The purpose of this statement is to clarify previous pronouncements relating to the scope of the independent auditor's review of internal control as it pertains to his examination leading to an expression of opinion on the fairness of financial statements. No attempt is made in this statement to consider the scope of reviews of internal control by the independent auditor for other purposes, such as special engagements involving system surveys, revisions, etc."

District of Columbia Institute of Certified Public Accountants, Committee on Governmental Accounting. *Cost Control in the Federal Government.* Washington, D.C.: The Institute, 1958. 12 pp. Limited number of copies available at the office of the D.C. Institute free of charge.

This pamphlet is the second in a series designed to provide further information on the financial practices of the federal government. It treats the all-important problem of cost control under the following headings: Background of Accounting and Budgeting in the Federal Government, Accrual Accounting System, Budgeting in the Federal Government, The Cost-Based Budget, and Accrued Expenditure Appropriations.

Gotherman, J. E., Sr. *Salaries and Fringe Benefits for Public Employees.* Chicago, Ill.: Municipal Finance Officers Association of the United States and Canada, 1958. 9 pp. $0.75.

This pamphlet was issued as Special Bulletin 1958G and contains a comprehensive coverage of salaries and fringe benefits for public employees.

Irving, Robert H., Jr., and Verden R. Draper. *Accounting Practices in the Petroleum Industry.* New York: Ronald Press, 1958. 274 pp. $6.00.

All the basic operations of the petroleum industry, from leasing prospective producing properties to refining processes, transportation,

and marketing the end products, are clearly and succinctly described. The reasons for the accounting practices followed are given at each stage, thus giving the reader a coherent, easy-to-follow picture of petroleum accounting.

This book surveys the generally accepted alternative methods of accounting for the frequently encountered transactions that are peculiar to the petroleum industry. These methods are fully explained in their many special applications with the objective that eventually the wide variations in practice may be reduced.

Paton, William A., Jr. *A Study in Liquidity.* Ann Arbor, Mich.: Bureau of Business Research, University of Michigan, 1958. 185 pp. $5.00.

"The sharp and sustained increase in the level of prices in the United States in recent years has rendered conventional accounting measurements and statements inaccurate and dangerously misleading. The problem is receiving considerable attention, with discussion and research focusing primarily on problems of inventory valuation and measurement of periodic depreciation and plant asset costs. This study, an analysis of fifty-two industrial corporations for the period 1941–1956, measures and appraises the significance of losses sustained on the 'monetary' accounts—cash, government securities, and short-term receivables. These purchasing power losses, not reported at all by the ordinary accounting process, are found to be very substantial. The study further indicates a definite need for critical reappraisal by management of traditional concepts of corporate liquidity and working capital management."

Peloubet, Sidney W., and Herbert Heaton. *Integrated Auditing.* New York: Ronald Press, 1958. 272 pp. $7.00.

The authors present the audit function in its full perspective as a vital element in business operation and control. The book gives the reader a clear understanding of why particular methods are employed and of the ultimate objectives to be attained. Of special interest to some is the fact that the book may be adapted to training of auditors through a staff training program and practice material located at the end of the book.

Riebel, John P., and Donald R. Roberts. *Ten Commandments for Writing Letters That Get Results.* New London, Conn.: Printers' Ink Books, 1958. 184 pp. $6.00.

A helpful guide in the writing of letters, this book, in addition to giving the basic rules of good letter writing includes suggestions and examples of modern ways of writing letters.

ARTICLES

American Institute of Certified Public Accountants. "Accounting in the Eighty-fifth Congress," Editorial, *Journal of Accountancy,* 106 (Sept. 1958), 25–26.

The editorial comments on the bills dealing with accounting which were considered by the Eighty-fifth Congress.

Barr, Andrew. "Canadian Accounting and the Securities and Exchange Commission," *Canadian Chartered Accountant,* 73 (Nov. 1958), 424–433.

The actual contacts of the Canadian accounting profession with the SEC comes from certifying financial statements included in registration statements and annual and other reports filed with the SEC. Mr. Barr, Chief Accountant for the SEC, discussed with the Chartered Accountants the following items: independence, the adequacy of the audit, forms required, letters of comment, auditors' opinions, deficiencies in filing, and the differences in Canadian and U.S. reporting.

Bennett, Clinton W. "Management Services by C.P.A.'s," *Accounting Review,* 33 (Oct. 1958), 602–614.

Mr. Bennett defines management services as any services which a certified public accountant may render to his clients beyond the customary auditing and tax practice. The author describes the type of services rendered by the certified public accountants at the turn of this century and presents an historical review to substantiate the view that management services is not a new development for the public accountant. Mr. Bennett divides management services into three general, yet distinct, classifications: (1) services which a certified public accountant, a member of a recognized professional society, should be capable of performing; (2) services requiring specialized experience; and (3) services requiring specialized training and experience.

The author lists the types of services that would be rendered under each classification. He concludes by stating that some of the services to management should be a generally accepted part of the practice of public accountancy and that some of the services in the broader areas were neglected by the public accountant and performed by others.

Bierman, Harold, Jr. "A Theory of Depreciation Consistent with Decision-Making," *The Controller,* 26 (Aug. 1958), 370–371, 393.

The author describes a means of allocating the depreciation charge so that the return on investment is undistorted.

Carey, John L. "The Place of the CPA in Contemporary Society," *Journal of Accountancy,* 106 (Sept. 1958), 27–32.

This is the second in a series of articles outlining tentative conclusions of the committee on long-range objectives of the American Institute of Certified Public Accountants. The first article, "The Accounting Function in Economic Progress," appeared in the August issue of the *Journal.* Questions concerning the CPA, such as his origin, the scope of his practice, the exclusive rights he can claim, the relation of his work to that of others engaged in some phase of the "accounting function" are discussed by the Executive Director of the Institute. Other questions related to the present position and further opportunities of certified public accountants are also discussed.

Cato, Erle. "Better Federal Government Accounting—The Accrued Cost Basis," *N.A.A. Bulletin,* 40 (Nov. 1958), 65–70.

"Decrying the concept of 'accrued expenditures' now recognized, as not going to the heart of deficiencies in government accounting, the author of this article proposes cost of programs as the sound basis for Congressional appropriations and subsequent control and accounting."

Cleaver, Goodrich F. "Auditing and Electronic Data Processing," *Journal of Accountancy,* 106 (Nov. 1958), 48–54.

"Although most of the material covered in this bibliographic commentary has been published since 1950, the author found one significant article which appeared ten years before that.

"The principal suggestions made in twenty-two books, pamphlets, and articles dealing with audit problems arising from machine and electronic accounting are briefly outlined. Mr. Cleaver has thus provided a ready reference guide to a subject which is increasing rapidly in importance."

Edwards, James Don. "This New Costing Concept—Direct Costing," *Accounting Review,* 33 (Oct. 1958), 561–567.

The author presents a clear, concise discussion of the problems of

direct costing and some of the fallacies inherent in the direct costing method. The author states that "this central point of controversy between conventional costing and direct costing probably cannot be resolved except on the basis of opinion. The two techniques are not necessarily mutually exclusive, but there is a practical limit to the quantity of accounting which any one company can profitably support. Direct costing with adjustments to make its results acceptable for external purposes or conventional costing with flexible budgets and cost-volume analysis can provide the same information." He concludes that "if accounting theory and practice is so 'flabby' that the direct costing theory becomes acceptable for reporting purposes, the progress of the last 500 years will be 'gone by the boards.'"

Ehmann, Franklin R. "Problems of Cost Control under Varying Volume Conditions," *The Controller,* 26 (Sept. 1958), 424–427, 445.

The author presents a graphic illustration of the workings of the cost-volume-profit relationship to show how costs behave.

Kempster, John H. "Economic Yardsticks in Management Reports," *N.A.A. Bulletin,* 40 (Sept. 1958), 5–15.

This article includes seven graphs and a tabular presentation as examples of significant comparisons of a company with industry or general economic conditions. Growth, sales, and cost trends are shown and the relevance of the data commented upon by the author in the text.

Livingston, W. G., and E. B. Mills. "Return on Investment—A Guide to Decision-Making," *N.A.A. Bulletin,* 40 (Oct. 1958), 15–29.

"The decisions treated here as facilitated by return-on-investment determinations are making vs. buying, leasing vs. buying, adding a process step in manufacturing, purchasing and inventory policy, and product pricing." The author presents examples in each of these areas.

Seney, Wilson. "The Changing Cost-Volume-Profit Relationship," *N.A.A. Bulletin,* 40 (Sept. 1958), 3–14.

The author summarizes "the current thinking of business managers about the trends in the economy, and. . .how their thinking is reflected in the ways in which they plan and operate their companies." The comments about the thinking and practices of today's managers was presented in this sequence: long-term trends, the current situation, the

impacts of long-term trends on the thinking of business managers, and how managers are planning and controlling cost-volume-profit relationships.

Shonting, D. M., and L. D. Stone. "Auditing Electronic Systems," *Journal of Accountancy,* 106 (Oct. 1958), 54–61.

"The audit of financial records produced electronically does not differ basically from the audit of conventional records, but the procedures may vary considerably. It is desirable that the auditor shall participate in the installation of the electronic system so he can make sure that there will be an adequate 'audit trail.'

"An added responsibility which the auditor may assume when electronic equipment is issued is verification of machine controls and system checks. For this, the auditor must be trained in systems analysis and programming techniques."

Tobin, Benjamin J. "Accounting for Public Service Enterprises," *Municipal Finance,* 31 (Nov. 1958), 90–96.

The author outlines a procedure for accounting for public enterprises which substantially follows practices used in private enterprise to account for similar-type functions.

Villers, Raymond. "The Managerial Approach to Budgeting," *The Controller,* 26 (Oct. 1958), 478–480, 508.

"The budget is a tool whose effective use depends on management's attitude."

Warne, Richard A. "Reporting—The Accountant's Share in Scientific Management," *N.A.A. Bulletin,* 40 (Oct. 1958), 81–88.

The author expresses the belief that the accountant shares in the planning, organizing, motivating, and controlling functions of management largely through the impact of reports and delineates and exemplifies the types of reports most likely to be effective.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

The Federal Accountant, published quarterly at Washington, D.C., for October 1, 1958.

1. The names and addresses of the publisher, editor, managing editor, and business managers are:

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2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

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4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

MARTIN C. POWERS, *Business Manager*

Sworn to and subscribed before me this 6th day of October, 1958.

[SEAL] ALICE O. REDFEARN, Notary Public
(My commission expires April 14, 1962.)